



WORKING PAPER SERIES

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Working Paper 2003-011E
<http://research.stlouisfed.org/wp/2003/2003-011.pdf>

May 2003
Revised July 2004

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Business Cycle Phases in U.S. States^{*}

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July 2004

Abstract

The U.S. aggregate business cycle is often characterized as a series of distinct recession and expansion phases. We apply a regime-switching model to state-level coincident indexes to characterize state business cycles in this way. We find that states differ a great deal in the levels of growth that they experience in the two phases: Recession growth rates are related to industry mix, whereas expansion growth rates are related to education and age composition. Further, states differ significantly in the timing of switches between regimes, indicating large differences in the extent to which state business cycle phases are in concord with those of the aggregate economy. (JEL: E32, R12)

^{*} The authors thank Francis Diebold, James Stock, Michael Boldin, Martin Sola, Jim Hamilton, and two anonymous referees for their comments, along with seminar participants at the University of Virginia, West Virginia University, and the conference on The Use of Composite Indexes in Regional Analysis, held at the Philadelphia Fed. Abigail Chiodo, Michelle Meisch, and Mark Opitz provided research assistance. The views expressed herein are the authors' alone and do not necessarily reflect the views of the Federal Reserve Bank of St. Louis or the Federal Reserve System.

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I. Introduction

There is a long tradition among macroeconomists, exemplified by the work of Burns and Mitchell (1946), of characterizing the U.S. aggregate business cycle as a series of distinct phases. This tradition is carried on today by the National Bureau of Economic Research's (NBER) Business Cycle Dating Committee. The NBER produces a single set of turning points defining the two most obvious business cycle phases—expansion and recession—as well as various summary statistics regarding the behavior of economic activity within these phases. Harding and Pagan (2002) provide a modern example of aggregate business cycle analysis from the Burns and Mitchell perspective.

Despite the considerable effort devoted to dating national recessions, little corresponding work has been done at the regional or state levels. Primarily, the literature has looked for co-movements in regional growth after splitting growth rates into their components—trend, cycle, national, and/or regional (Quah, 1996; Clark, 1998; Carlino and Sill, 2001; Kouparitsas, 2001). In this sense, research has been in the spirit of the macro literature examining growth cycles (i.e., deviations from trend), which is the primary alternative to the Burns and Mitchell/NBER analysis. To date, though, the literature has not studied regional business cycle phases, which need not necessarily be in sync with national phases.¹

To remedy this, we use the state coincident index data of Crone (2002), based on Stock and Watson (1989), to present evidence regarding the timing and characteristics of state-level business cycle phases. We are particularly interested in two questions: (1) How similar are the states in terms of their growth rates in recession and expansion, and what might explain the

¹ An exception is Guha and Banerji (1998/1999), who use employment data to suggest that the business cycle phases of California, New York, Illinois, and Florida have been different from those of the United States as a whole.

differences in growth rates? (2) To what extent have states' recession/expansion experiences been in sync with each other's and with that of the country as a whole?

As the NBER chronology is available only for U.S. aggregate economic activity, alternative methods must be used to identify business cycle turning points in regional data. One popular approach is the algorithm given in Bry and Boschan (1971), which is designed to identify turning points between periods of expansion and contraction in the level of a time-series. The Bry and Boschan procedure identifies local minima and maxima in the series, enforcing that business cycle phases are of some minimum length. An alternative, newer, entrant into the field of business cycle dating is the Markov regime-switching model of Hamilton (1989). Hamilton specifies a parametric time-series model in which the mean growth rate switches between high and low growth regimes. The timing of these regimes and the within-regime growth rates are then estimated from the data.

Both the Bry and Boschan and Hamilton approaches have been shown to produce a reasonably accurate replication of the NBER chronology when applied to aggregate data.² The Bry and Boschan algorithm has the virtue of being very transparent, as it takes the form of a simple data-driven rule for dating turning points. However, for state-level data, the Hamilton approach has the advantage over the Bry and Boschan algorithm of not requiring that recessions be absolute declines in economic activity. With regional data, it is quite possible that a given region might experience positive growth rates during recession, as the average growth rate for that region might be higher than the national average. Preliminary analysis suggests this is true for several U.S. states, and that in these cases the Bry and Boschan algorithm has difficulty

² See for example Boldin (1994), Chauvet and Piger (2002) and Harding and Pagan (2002).

identifying business cycle phases.³ As a result, we focus our analysis here on business cycle phases identified using a Markov-switching model similar to that in Hamilton (1989).

In the next section, we outline the Markov-switching model that we use and describe our estimation and data in section III. In section IV we address questions (1), while in sections V, VI, VII, and VIII we address question (2). Section IX concludes.

II. Dating Business Cycle Phases Using a Markov-Switching Model

The Hamilton (1989) Markov-switching model identifies business cycle phase shifts as shifts in the mean growth rate of a parameteric statistical time-series model for economic output. That is, different business cycle phases are treated as arising from different models. Here we specify a simple model for the growth rate of some measure of economic activity, y_t :

$$y_t = \mu_{S_t} + \varepsilon_t,$$

$$\varepsilon_t \sim N(0, \sigma_\varepsilon^2), \tag{1}$$

$$\mu_{S_t} = \mu_0 + \mu_1 S_t, \quad \mu_1 < 0;$$

where the growth rate has mean μ , and deviations from this mean growth rate are created by the stochastic disturbance ε_t . To introduce recession and expansion phases, allow the mean growth rate in (1) to switch between two regimes, where the switching is governed by a state variable, $S_t = \{0,1\}$. Because S_t is unobserved, estimation of (1) requires that we place restrictions on the probability process governing S_t . We assume that S_t is a first-order two-state Markov chain.

³ Indeed, Harding and Pagan (2002) have shown that the business cycle dates emerging from the MS model can be approximated by a simple algorithmic dating rule, providing easier comparison to the Bry and Boschan algorithm. A primary difference that becomes apparent from this comparison is that the magnitude of growth rates needed to trigger a regime shift in the Hamilton model will change from state to state, whereas they remain constant across states in the Bry and Boschan algorithm.

This means that any persistence in the regime is completely summarized by the value of the state in the last period. Under this assumption, the probability process driving S_t is captured by the transition probabilities $\Pr[S_t = j \mid S_{t-1} = i] = p_{ij}$.

The model in (1) implies that, when S_t switches from 0 to 1, the growth rate of economic activity switches from μ_0 to $\mu_0 + \mu_1$. Since $\mu_1 < 0$, S_t switches from 0 to 1 at times when economic activity switches from higher-growth to lower-growth states, or vice versa.⁴ Hamilton applied this model to the growth rate of U.S. Gross National Product and found the best fit when $\mu_1 > 0$ and $\mu_0 + \mu_1 < 0$, suggesting that the model identified regimes when the economy was expanding as opposed to when it was contracting. The estimated probability that $S_t = 1$ conditional on all the data in the sample, denoted $\Pr[S_t = 1 \mid \Omega_T]$, corresponded very closely to the recession dates established by the NBER Business Cycle Dating Committee. This was particularly striking in that Hamilton estimated his model with only one variable describing economic activity.

The model in (1) could be complicated on various dimensions, such as allowing for dynamics, which would improve the model's fit of the data. We choose to focus on the simple shifting mean model in (1), as our primary goal is to date regime shifts between high and low mean growth regimes. More highly parameterized models that improved statistical fit would be useful if our goal were instead to determine whether the data generating process for the state-level data was linear or nonlinear, an interesting question that we do not address here. In this regard however, it is interesting to note that Diebold and Rudebusch (1996) find substantial evidence of non-linearity for the U.S. aggregate coincident index.

⁴ This identifying restriction is necessary for normalization, as without this restriction one can always reverse the definition of the state variable and obtain an equivalent description of the data.

III. Data and Estimation

Our data are the monthly state coincident indexes described in Crone (2002), which, at the time of writing, are available for 1979:01 - 2002:06. One of the major hurdles in state-level analysis is the unavailability of suitable data. Aggregate business cycle models usually use a broad measure of economic activity such as Gross Domestic Product (GDP), but this is not feasible for examining state business cycles because the corresponding measure—Gross State Product (GSP)—is available at only a yearly frequency and with a lag of two years. Because of these problems, the state/regional studies cited above use personal income as their broad measure of an economy's performance. Personal income is not suitable for our purposes, however, because it does not fluctuate very much with the business cycle. In contrast, the state coincident indexes we use here display substantial business cycle variability.⁵

The model in (1) is estimated using the multi-move Gibbs-sampling procedure implemented by Kim and Nelson (1998) for Bayesian estimation of Markov-switching models.⁶ Briefly, the Gibbs sampler iteratively draws from the conditional posterior distribution of each parameter (including the S_t , for $t = 1, \dots, T$) given the data and the draws of the other parameters of the model. These draws form an ergodic Markov chain whose distribution converges to the joint posterior distribution of the parameters given the data. In simulating this posterior

⁵ Although the model is applied to a single economic time series for each state, it provides a richer picture of the economy than one might assume. This is because each coincident index series captures the co-movement of several underlying economic variables, meaning that our model can be interpreted as capturing regime shifts in a common factor underlying several series. Diebold and Rudebusch (1996) make this point in discussing the aggregate U.S. coincident index.

⁶ See Casella and George (1992) and Kim and Nelson (1999) for detailed descriptions.

distribution, we discard the first 2000 draws to ensure convergence. Descriptive statistics regarding the sample posterior distributions are then based on an additional 10,000 draws.

Bayesian estimation requires that we specify prior distributions for the model parameters. The prior for the switching mean parameters, $[\mu_0, \mu_1]'$, is Gaussian with mean vector $[1, -1]'$ and a variance-covariance matrix equal to the identity matrix I . The transition-probability parameters, p_0 and p_1 , have Beta prior distributions, given by $\beta(9,1)$ and $\beta(8,2)$ respectively.⁷ The variance parameter, σ_ε^2 , has an improper inverted-gamma distribution.⁸

IV. Within-Regime Growth Rates

Our first set of results, the state-level monthly growth rates in the two regimes, are presented in Table 1 along with their 90-percent coverage intervals.⁹ For each state, the difference between regimes is economically large and statistically important, indicating that the regimes are well separated. For every state, the expansion growth rate is positive and for every state except Arizona, Delaware, and New Mexico, the recession growth rate is negative. Note, though, that a recession growth rate of zero is within the coverage interval for Delaware and five states whose estimated recession growth rates are negative: California, Colorado, Georgia, New York, and Utah.

As is obvious from the table, there are large cross-state differences in each regime. For example, whereas the median recession growth rate across the states is -0.18 percent per month,

⁷ These priors would imply means of 0.9 and 0.8 and standard deviations of 0.09 and 0.12, respectively.

⁸ This prior distribution is improper in the context of O'Hagan (1994, p. 245), in that it specifies a distribution with infinite moments. However, this prior yields a proper posterior distribution (Albert and Chib 1993 and O'Hagan 1994, p. 292).

⁹ Our estimate of a growth rate is the mean of its posterior distribution.

there are five states—Massachusetts, Michigan, Oklahoma, West Virginia, and Wyoming—whose economies contract at more than three times this rate during a recession. In addition, there are eleven states whose economies contract by less than one-third of this rate during a recession. There is somewhat of a regional pattern to the state-level recession growth rates. In particular, the manufacturing states in the western Great Lakes area are all among those that contract the fastest while in recession. Those that contract the slowest during recession are in the southern Rocky Mountain area—Arizona, Colorado, New Mexico, and Utah—and the mid-Atlantic area—Delaware, New Jersey, and New York.

The cross-state differences in growth rates during expansion are also large. Whereas the median monthly growth rate is 0.38 percent, five states have expansion growth rates more than 15 basis points above this—Alaska, Arizona, Nevada, New Hampshire, and Washington—and three—Louisiana, North Dakota, and Oklahoma—have expansion growth rates more than 15 basis points below this. The high-growth states tend to be located in the West, New England, and the Southeast.

As a first step in explaining these cross-state differences in growth rates, we regressed them on several industrial, demographic, and tax variables. We included the states' employment shares in manufacturing; construction and mining; and finance, insurance, and real estate (FIRE). We also included two education variables: the share of a state's population aged 25 and older with a high school diploma (but no college degree) and the share of the same population with a bachelor's degree. To control for state-level age differences, we include the share of a state's population that is of prime working age (18-44). Finally, we also include the maximum marginal

tax rates on wages and salaries and on capital gains, combining the state and federal rates generated by the NBER's TAXSIM model.

Our regression results are reported in Table 2 and suggest that there are significant differences between regimes in the types of factors that determine growth rates. On the one hand, state-level differences in recession growth rates tend to depend on the predominance of recession-sensitive industries, but not on demographics or tax rates. Specifically, a state whose share of employment in manufacturing is one standard deviation higher would tend to see a yearly recession growth rate that is about 1 percentage point lower. Similarly, a one-standard-deviation-higher share of employment in construction and mining would tend to mean a 2-percentage-point lower yearly recession growth rate. None of the other variables have coefficients that are statistically different from zero.

On the other hand, state-level differences in expansion growth rates appear to be related to differences in demographics, but not to industrial composition or tax rates. A one-standard-deviation-higher share with a high school diploma is related to a yearly expansion growth rate about one-third of a percentage point higher. Interestingly, states with a higher share of population with a bachelor's degree have no statistically significant growth advantage. A state's age profile also appears to matter. A one-standard-deviation-higher share aged 18-44 is associated with an expansion growth rate that is about a one-percentage-point higher. This result, however, might simply be a reflection of the tendency of prime-aged workers to migrate to high-growth states.

V. State-Level Regime Switching

In addition to the growth rates in the two regimes, the model produces for each state and month the estimated probability that the state is in a recession. To illustrate some of the variety at the state level, Figure 1 presents the monthly recession probability over the sample period for six selected states—California, Florida, Maryland, Missouri, New Mexico, and Texas. These states were selected because each is roughly representative of a sub-group of states. There is a great deal of state-level variety not illustrated in Figure 1, however, and the complete set of monthly state recession probabilities is available at <http://research.stlouisfed.org/wp/more/2003-011/>.

For reference, the charts in Figure 1 include shaded areas to indicate periods of national recession as determined by the NBER. Although relatively short, the sample period provides a rich variety of experiences. It included four national recessions of varying lengths and causes punctuated by three expansions—one short and two long.¹⁰

The first thing to notice about the state recession probabilities is that, for each period, they tend to be close to 0 or 1, indicating that at any point in time it is usually a simple matter to say whether each state's economy is in its recession or expansion phase. The second thing to notice is that the phases tend to last for at least several periods, meaning that the model is detecting persistent changes in the mean growth rates. And, finally, while state-level recessions tend to be associated with national recessions, there is still a great deal of state-specific variation in the timing and length of recessions.¹¹ Specifically, individual states can (i) switch into or out

¹⁰ The dates of the national recessions are 1980:01-1980:07, 1981:07-1982:11, 1990:07-1991:03, and 2001:03-2001:11.

¹¹ Note that we adopt the admittedly arbitrary convention that a state is in recession when its recession probability exceeds 0.5.

of recession long before or long after the nation as a whole does, (ii) be in expansion during the entire time that the nation is in recession, and (iii) experience a recession that is not associated with any national recession.

Given that it is the largest and most economically diverse state, it is not too surprising that California's recession/expansion history is similar to that of the nation as a whole. Specifically, its economy experienced all four national recessions and no idiosyncratic recessions. Its most obvious deviation from the national experience was its extremely long recession associated with the national 1990-91 recession. California remained in recession until March 1994.

Because Florida and Missouri are relatively diverse economies, they might be expected to follow the national economy quite closely. Each state, however, has experienced significant business cycle idiosyncrasies. Namely, Florida did not experience the 1980 recession and did not switch out of the 1990-91 recession until about a year after the country as a whole. Missouri, on the other hand, saw one long recession between July 1979 and December 1982, never seeing the brief expansion phase between the 1980 and 1981-82 national recessions. More recently, Missouri switched into recession in August 2000, seven months before the national economy did.

Maryland is a state whose recession experience has elements of those of many other states, but has a business cycle that is very different from that of the nation as a whole. As with Missouri, Maryland saw one long recession from 1979 into 1982, and, as with California, it saw a much longer recession in the early 1990s than did the country, although Maryland's also began earlier. Most interestingly, Maryland experienced a mid-1990s recession that was not experienced by the national economy.

New Mexico’s recent recession history is among the most peculiar because it experienced three non-national recessions in addition to four recessions that were roughly in line with national recessions. Recall, though, that New Mexico’s business cycle is also peculiar in that its recession growth rate is positive.

Because of the importance of the energy sector, the business cycle of Texas was often out of sync with the country as a whole. It did not experience a recession in 1980 and missed the first half of the 1981-82 recession. It had an energy-related recession in the mid-1980s that was also experienced by several other states—but not the country—and it was not in recession again until 2001.

As mentioned above, the business cycle experience of these six states is far from exhaustive of the state-level variety of switches into and out of recession. Although we will not discuss them in detail, notably interesting business cycles have been experience by Alaska, Arizona, Delaware, Hawaii, Maine, Montana, Washington, and any Plains or energy-intensive state.

To provide a more general picture of how the states’ business cycles relate to each other and to that of the national economy, we constructed Tables 3a and 3b, which condense our monthly results into quarters. The tables indicate with a “■” when a state was in recession in any month within a quarter over the sample period. In addition, the shaded regions indicate when the national economy was in a recession. From these tables, one can see all at once the variety of recession/expansion experiences across the 50 states.

Tables 3a and 3b provide a great deal of information about the business cycles of each of the 50 states. Our present interest is in the general lessons that can be drawn from the results,

rather than an exhaustive dissection of each state's business cycle experience over the past 24 years. It is left to the reader to tackle each line and column of Tables 3a and 3b, not to mention the 50 monthly recession probability charts, at his or her leisure.

There are four notable general results illustrated by Tables 3a and 3b. (i) A large number of states tend to be in recession earlier than and/or longer than the country as a whole. In the case of the 1990-91 recession, many were in recession at least an entire year before and/or after the national economy had switched. (ii) In 1980, 1990-91, and 2001, a significant number of states remained in expansion while the nation as a whole was in recession. (iii) The 1981-82 national recession achieved near-unanimity at the state level. (iv) Fifteen states experienced recession in the mid-1980s when the national economy was in a long expansion phase.

VI. The Persistence of Expansion and Recession

Now consider Table 4, which presents the conditional expectation of a state remaining in a regime, along with the expected duration of each regime. Two facts are immediately apparent. First, for every state in either regime, the probability of remaining in the current regime is much greater than the probability of switching to the other one; i.e., the regimes are persistent. Second, for most states, the expected expansion duration is much longer than the expected recession duration. This suggests that, while each state experiences relatively short recessionary periods, the baseline regime is expansion.

It is clear from Table 4 that there are very large cross-state differences in the expected durations of expansions and recessions. Whereas the median expected duration of an expansion is 52 months, for five states the expected duration of an expansion is at least a year shorter than

this. For Alaska and New Mexico, it is more than two years shorter. At the other end, there are 14 states whose expansions are expected to last at least a year longer than that of the median state. For half of these, expansions are expected to last two years longer than the median state's. The cross-state differences in recession durations are similarly large. The median state has an expected recession duration of 17 months, but for five states it is at least half of a year shorter, and for 14 states it was at least half of a year longer.

VII. The Geography of National Recessions

The catalogue of state-level recessions provided by Tables 3a and 3b can be used to provide a geographic perspective on the relationship between state and national recessions. There were distinct regional patterns to the four national recessions that occurred between 1979 and 2002. In addition, there was a non-national recession during the mid-1980s, when a large number of states were in recession but the country as a whole was not. Slide shows of the quarter-by-quarter geographic distribution of state-level recessions for each of these periods are available at <http://research.stlouisfed.org/wp/more/2003-011/>.

The 1980 and 1981-82 national recessions

The two national recessions of the early 1980s occurred with only one year separating them, so we present them as one long event. Given that 13 states never left the first recession before the second one began nationally, this is particularly appropriate in the present context. As the first map in Figure 2 shows, 22 states spread across the country were in recession in the third quarter of 1979—three quarters before the national recession began. Except for the far west of the country, every region had some states that were in recession this far ahead of the country. By

the mid-point of the recession in the second quarter of 1980, nearly all states had entered recession. The exceptions were the oil states of Texas, Oklahoma, and Louisiana, along with Florida and Wyoming. The national recession ended in the third quarter of 1980, but two quarters later, 20 states were still in recession. These included most of the states in the Mississippi and Missouri valleys, as well as the southern mid-Atlantic states. Of these 20 states, 13 never switched out of the 1980 recession and experienced one long recession spanning the two national recessions.

The second national recession of the early 1980s was even more geographically widespread than the first: All 48 contiguous states were in recession at its mid-point in the second quarter of 1982. Once the recession ended at the national level, it ended fairly quickly across the states. Although there were 18 states still in recession one quarter later (located in the Southwest, southern Rocky Mountains, and around the Great Lakes), this was reduced to five by the next quarter.

The 1990-91 national recession

The national recession of 1990-91 exhibited particularly distinct geographic patterns. As shown by Figure 3, most of the states in the Northeast, along with Michigan and Arizona, were in recession at least five quarters before the national recession began. By the quarter just prior to the national recession, another eight states (primarily down the east coast) had switched into recession. In the middle of the national recession, nearly the entire eastern half of the country was in recession, as were the far western states. On the other hand, most states between Montana and Texas were still in expansion, with Nebraska being the only of these to switch into recession at all.

A well-known feature of the 1990-91 national recession was its lingering effects in some parts of the country, a feature borne out by our results. Two quarters after the end of the national recession, there were 20 states—nearly all on the eastern and western edges of the country—that had not yet switched into expansion. Furthermore, even five quarters after the recession had ended at the national level, at the state level it had merely receded to the Northeast and was continuing in most of the West and Southwest, where it lasted for several more quarters.

The 2001 national recession

The most recent national recession, which began in the first quarter of 2001, began in parts of the country well before this. As Figure 4 shows, there were 14 states, including much of the South, that were already in recession by the third quarter of 2000. By the next quarter the recession had spread throughout the Midwest and was experienced almost nationwide at its midpoint. Except for scattered switches into expansion, 37 states were still in recession in the second quarter of 2002 despite the fact that, according to the NBER, the national recession had ended two quarters earlier.

The 1985-86 non-national recession

There were four national recessions during the 23-year period we have considered, each with its own geographic dimension. In addition, there was a period in the mid-1980s when a significant number of states experienced a recession that was confined to a distinct geographic swath of the country. Specifically, while the national economy was in expansion, 14 states were in recession during the last quarter of 1985 and/or the first quarter of 1986. These states included nearly every state between Idaho and Louisiana. There was a plunge in oil prices during this

period, which, because many of these states have large energy sectors, may explain the root of their recessions. Around the same time, the recessions in the Plains states were likely due to the mid-1980s farm crisis. The rest of the country, however, reveled in the low energy prices and continued with its long expansion.

VIII. Concordance

As we have described above, although there is a general tendency for states to experience recessions that are associated with national recession, state recessions differ from the nation's in length and timing. In addition, states frequently experience recessions that are not associated with any national recessions, or continue to be in expansion throughout periods when the country is in recession. The precise extent to which the state cycles are in sync with the national cycle remains an open question.

Harding and Pagan (2003) measure the degree to which two business cycles are in sync by the percentage of time the two economies were in the same regime—their degree of concordance.¹² Specifically, the degree of concordance between the business cycles of state i and the United States is

$$C_{i,US} = \frac{1}{T} \sum_{t=1}^T [s_{it}s_{US,t} + (1 - s_{it})(1 - s_{US,t})] \quad (2)$$

where t denotes the period and T is the total number of periods. The state-nation concordance measures are reported in Table 5. Note that these concordance measures should be interpreted relative to a an expected value for $C_{i,US}$ under the null hypothesis that the business cycles of

¹² We use the same U.S. peak and trough dates as in Figure 1 and Tables 4a and 4b.

state i and the United States are uncorrelated, which need not be zero if one business cycle phase is more persistent than the other. Table 5 also reports these expected concordance measures.

Perhaps not surprisingly, Alaska and Hawaii were, by far, the least in sync with the national economy, having been in the same regime as the country only 21 and 57 percent of the time, respectively. Of the 48 contiguous states, Maine, Delaware, Arizona, Louisiana, and New Mexico were in the same regime as the nation less than 75 percent of the time. At the other end, eleven states were in sync with the national cycle more than 90 percent of the time. Massachusetts and Minnesota had the highest degrees of concordance, 0.94 and 0.96, respectively.

There are some clear regional patterns to the concordance numbers. In particular, in addition to the non-contiguous states, all but one state between Montana and North Dakota in the north to Arizona and Texas in the south are in the lower third of states in terms of their concordance with the national business cycle. Note that many of these states experienced recession in the mid-1980s while the country was in expansion and remained in expansion during 1990-91 while the country was in recession. Washington, Maine, Delaware, and Maryland are somewhat idiosyncratic in that their cycles are much less similar to the national cycle than are those of their immediate neighbors. In contrast, most of the South and much of the Rust Belt has tended to be relatively in sync with the national cycle.

This analysis cuts both ways. While our state-level concordance measure shows how similar/dissimilar states are to the nation, it also indicates how the national recessions may be representative of the coastal economies. In other words, Table 5 reflects states' relative discordance with the nation and the nation's relative discordance with some states. Thus, one

might conclude that the national recessions as measured with aggregate data are less reflective of middle America and more indicative of the East and Far West.

IX. Concluding Remarks

Macroeconomists often characterize the aggregate U.S. business cycle as a series of distinct recession and expansion phases. Little to no attention has been paid, however, to business cycle phases at the state and regional level. To remedy this, we use a regime-switching model and the state coincident index data of Crone (2002) to present evidence regarding state-level business cycle phases.

We find that there are significant differences across states in the growth rates within business cycle phases. We also find that, although state-level recessions are usually associated with national recessions, their peaks and troughs differ greatly and are not in sync with national peaks and troughs. For example, in the case of the 1990-91 recession, many states were in recession for more than a year before and/or after the national economy had switched. In addition, it is not uncommon for state business cycles to be completely out of sync with the national cycle. For example, although the nation as a whole was in recession in 1980, 1990-91, and 2001, many states did not experience a recession at all during one or more of these periods. Conversely, 14 of the 48 contiguous states experienced recession in the mid-1980s, when the aggregate economy was in the middle of a long expansion.

In terms of their concordance with the national business cycle, states in the South and much of the Rust Belt tended to be relatively in sync with the national cycle. In contrast, states

between Montana and North Dakota in the north to Arizona and Texas in the south tended to be much less in sync with the nation as a whole.

Obviously, for state policymakers, there can be fairly significant benefits to knowing whether your state is in a recession or an expansion. Beyond this, our results also have potentially important implications for national policymaking. For example, if the national economy is in recession, the usual response of the Federal Reserve is to loosen monetary policy to smooth out the national business cycle. However, because the effect of monetary policy varies across states and regions (Carlino and DeFina, 1998 and 1999; Fratantoni and Schuh, 2003; Owyang and Wall, 2004), the resulting impact depends on the mix of states in and out of recession at the time the policy is implemented. A similar argument can be applied to the use of fiscal policy to smooth aggregate business cycles.

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Table 1. State Growth Rates in Recession and Expansion
(with 90-percent coverage intervals)

| State | Recession | Coverage Interval | Expansion | Coverage Interval | State | Recession | Coverage Interval | Expansion | Coverage Interval |
|---------------|-----------|-------------------|-----------|-------------------|----------------|-----------|-------------------|-----------|-------------------|
| Alabama | -0.224 | (-0.298, -0.145) | 0.320 | (0.288, 0.353) | Montana | -0.312 | (-0.367, -0.263) | 0.246 | (0.222, 0.271) |
| Alaska | -0.095 | (-0.142, -0.045) | 0.864 | (0.755, 0.977) | Nebraska | -0.091 | (-0.129, -0.053) | 0.340 | (0.316, 0.363) |
| Arizona | 0.078 | (0.036, 0.126) | 0.617 | (0.583, 0.656) | Nevada | -0.349 | (-0.463, -0.242) | 0.617 | (0.571, 0.662) |
| Arkansas | -0.165 | (-0.215, -0.117) | 0.348 | (0.322, 0.373) | New Hampshire | -0.162 | (-0.240, -0.091) | 0.557 | (0.525, 0.588) |
| California | -0.017 | (-0.042, 0.008) | 0.434 | (0.418, 0.449) | New Jersey | -0.014 | (-0.052, 0.025) | 0.371 | (0.351, 0.393) |
| Colorado | -0.013 | (-0.053, 0.025) | 0.443 | (0.422, 0.464) | New Mexico | 0.091 | (0.059, 0.124) | 0.442 | (0.416, 0.468) |
| Connecticut | -0.112 | (-0.159, -0.069) | 0.404 | (0.378, 0.430) | New York | 0.000 | (-0.026, 0.024) | 0.287 | (0.273, 0.301) |
| Delaware | 0.006 | (-0.024, 0.036) | 0.485 | (0.460, 0.512) | North Carolina | -0.222 | (-0.272, -0.171) | 0.455 | (0.427, 0.481) |
| Florida | -0.038 | (-0.074, -0.001) | 0.423 | (0.406, 0.441) | North Dakota | -0.360 | (-0.552, -0.214) | 0.208 | (0.156, 0.259) |
| Georgia | -0.016 | (-0.062, 0.029) | 0.482 | (0.459, 0.506) | Ohio | -0.179 | (-0.212, -0.147) | 0.266 | (0.250, 0.282) |
| Hawaii | -0.092 | (-0.129, -0.051) | 0.366 | (0.331, 0.404) | Oklahoma | -0.782 | (-0.961, -0.602) | 0.223 | (0.191, 0.255) |
| Idaho | -0.345 | (-0.423, -0.271) | 0.501 | (0.462, 0.538) | Oregon | -0.330 | (-0.392, -0.272) | 0.449 | (0.422, 0.477) |
| Illinois | -0.331 | (-0.371, -0.292) | 0.371 | (0.347, 0.396) | Pennsylvania | -0.319 | (-0.381, -0.254) | 0.306 | (0.277, 0.337) |
| Indiana | -0.425 | (-0.494, -0.355) | 0.367 | (0.337, 0.399) | Rhode Island | -0.255 | (-0.318, -0.197) | 0.428 | (0.393, 0.462) |
| Iowa | -0.166 | (-0.232, -0.117) | 0.260 | (0.233, 0.282) | South Carolina | -0.205 | (-0.265, -0.145) | 0.451 | (0.421, 0.482) |
| Kansas | -0.425 | (-0.515, -0.335) | 0.237 | (0.216, 0.260) | South Dakota | -0.172 | (-0.228, -0.120) | 0.380 | (0.350, 0.407) |
| Kentucky | -0.432 | (-0.496, -0.366) | 0.328 | (0.303, 0.353) | Tennessee | -0.150 | (-0.209, -0.093) | 0.413 | (0.384, 0.442) |
| Louisiana | -0.385 | (-0.439, -0.333) | 0.184 | (0.162, 0.207) | Texas | -0.163 | (-0.228, -0.062) | 0.354 | (0.332, 0.381) |
| Maine | -0.089 | (-0.147, -0.031) | 0.509 | (0.459, 0.563) | Utah | -0.009 | (-0.056, 0.029) | 0.466 | (0.440, 0.489) |
| Maryland | -0.112 | (-0.163, -0.065) | 0.448 | (0.411, 0.481) | Vermont | -0.212 | (-0.262, -0.161) | 0.443 | (0.415, 0.472) |
| Massachusetts | -0.558 | (-0.657, -0.459) | 0.509 | (0.465, 0.553) | Virginia | -0.037 | (-0.071, -0.001) | 0.370 | (0.352, 0.387) |
| Michigan | -0.928 | (-1.059, -0.804) | 0.397 | (0.347, 0.447) | Washington | -0.349 | (-0.433, -0.264) | 0.580 | (0.521, 0.637) |
| Minnesota | -0.286 | (-0.354, -0.206) | 0.381 | (0.354, 0.408) | West Virginia | -1.656 | (-2.373, -1.196) | 0.388 | (0.256, 0.507) |
| Mississippi | -0.078 | (-0.107, -0.048) | 0.338 | (0.317, 0.357) | Wisconsin | -0.248 | (-0.314, -0.185) | 0.324 | (0.298, 0.350) |
| Missouri | -0.145 | (-0.175, -0.116) | 0.304 | (0.286, 0.321) | Wyoming | -1.246 | (-1.335, -1.155) | 0.284 | (0.255, 0.315) |

Table 2. Regression Results for Recession and Expansion Growth Rates

| | Recession Growth Rate | | Expansion Growth Rate | |
|---|-----------------------|-------|-----------------------|-------|
| | coeff. | s.e. | coeff. | s.e. |
| Constant | 0.424 | 1.225 | -1.394* | 0.591 |
| Employment share of manufacturing | -0.014* | 0.008 | 0.002 | 0.004 |
| Employment share of mining and construction | -0.077* | 0.030 | 0.001 | 0.013 |
| Employment share of finance, insurance, and real estate | 0.027 | 0.035 | 0.003 | 0.014 |
| Share of 25+ population with HS diploma only | -0.011 | 0.009 | 0.006* | 0.003 |
| Share of 25+ population with a bachelor's degree | 0.006 | 0.018 | -0.002 | 0.006 |
| Share of population between ages of 18 and 44 | 0.020 | 0.022 | 0.039* | 0.013 |
| Max. marginal tax on wages and salaries (state+federal) | -0.004 | 0.033 | 0.012 | 0.021 |
| Max. marginal tax on capital gains (state+federal) | -0.010 | 0.047 | -0.029 | 0.028 |
| Root MSE | 0.283 | | 0.101 | |
| R ² | 0.332 | | 0.416 | |

Standard errors are White-corrected. A ‘*’ indicates statistical significance at the 10-percent level.

Table 3a. State Recessions and Expansions by Quarter, 1979:I - 1990:IV
(National NBER recessions indicated by gray background)

| | 1979.I | 1979.II | 1979.III | 1979.IV | 1980.I | 1980.II | 1980.III | 1980.IV | 1981.I | 1981.II | 1981.III | 1981.IV | 1982.I | 1982.II | 1982.III | 1982.IV | 1983.I | 1983.II | 1983.III | 1983.IV | 1984.I | 1984.II | 1984.III | 1984.IV | 1985.I | 1985.II | 1985.III | 1985.IV | 1986.I | 1986.II | 1986.III | 1986.IV | 1987.I | 1987.II | 1987.III | 1987.IV | 1988.I | 1988.II | 1988.III | 1988.IV | 1989.I | 1989.II | 1989.III | 1989.IV | 1990.I | 1990.II | 1990.III | 1990.IV |
|----------------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|--------|---------|----------|---------|
| Alabama | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Alaska | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Arizona | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Arkansas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| California | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Colorado | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Connecticut | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Delaware | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Florida | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Georgia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Hawaii | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Idaho | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Illinois | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Indiana | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Iowa | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Kansas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Kentucky | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Louisiana | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Maine | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Maryland | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Massachusetts | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Michigan | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Minnesota | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Mississippi | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Missouri | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Montana | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nebraska | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Nevada | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| New Hampshire | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| New Jersey | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| New Mexico | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| New York | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| North Carolina | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| North Dakota | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Ohio | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oklahoma | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Oregon | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Pennsylvania | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Rhode Island | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| South Carolina | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| South Dakota | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Tennessee | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Texas | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Utah | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Vermont | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Virginia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Washington | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| West Virginia | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wisconsin | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Wyoming | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

(National NBER recessions indicated by gray background)

[illegible]

Table 4. The Persistence of State-Level Expansions and Recessions

| State | Expansion | | Recession | | State | Expansion | | Recession | |
|---------------|--------------------------|-------------------|--------------------------|-------------------|----------------|--------------------------|-------------------|--------------------------|-------------------|
| | Probability of remaining | Expected duration | Probability of remaining | Expected duration | | Probability of remaining | Expected duration | Probability of remaining | Expected duration |
| Alabama | 0.975 | 50 | 0.913 | 14 | Montana | 0.980 | 64 | 0.923 | 16 |
| Alaska | 0.939 | 23 | 0.979 | 62 | Nebraska | 0.971 | 42 | 0.939 | 20 |
| Arizona | 0.971 | 43 | 0.964 | 36 | Nevada | 0.975 | 50 | 0.908 | 13 |
| Arkansas | 0.983 | 84 | 0.948 | 27 | New | 0.977 | 54 | 0.925 | 17 |
| California | 0.975 | 50 | 0.947 | 23 | New Jersey | 0.970 | 42 | 0.928 | 17 |
| Colorado | 0.967 | 35 | 0.931 | 17 | New Mexico | 0.949 | 22 | 0.930 | 16 |
| Connecticut | 0.975 | 51 | 0.943 | 22 | New York | 0.974 | 48 | 0.941 | 21 |
| Delaware | 0.977 | 63 | 0.966 | 38 | North Carolina | 0.977 | 54 | 0.928 | 17 |
| Florida | 0.982 | 75 | 0.943 | 23 | North Dakota | 0.968 | 43 | 0.855 | 9 |
| Georgia | 0.970 | 40 | 0.918 | 14 | Ohio | 0.982 | 72 | 0.928 | 17 |
| Hawaii | 0.968 | 42 | 0.962 | 34 | Oklahoma | 0.984 | 91 | 0.848 | 8 |
| Idaho | 0.975 | 49 | 0.913 | 14 | Oregon | 0.982 | 77 | 0.938 | 21 |
| Illinois | 0.981 | 69 | 0.955 | 30 | Pennsylvania | 0.972 | 44 | 0.906 | 13 |
| Indiana | 0.976 | 53 | 0.920 | 15 | Rhode Island | 0.979 | 64 | 0.931 | 17 |
| Iowa | 0.975 | 51 | 0.929 | 18 | South Carolina | 0.976 | 53 | 0.933 | 18 |
| Kansas | 0.985 | 95 | 0.862 | 9 | South Dakota | 0.983 | 89 | 0.936 | 19 |
| Kentucky | 0.975 | 47 | 0.876 | 9 | Tennessee | 0.976 | 52 | 0.936 | 19 |
| Louisiana | 0.983 | 76 | 0.931 | 19 | Texas | 0.982 | 73 | 0.917 | 16 |
| Maine | 0.970 | 43 | 0.960 | 32 | Utah | 0.978 | 61 | 0.955 | 30 |
| Maryland | 0.973 | 47 | 0.951 | 25 | Vermont | 0.970 | 40 | 0.923 | 15 |
| Massachusetts | 0.974 | 48 | 0.920 | 15 | Virginia | 0.977 | 54 | 0.940 | 21 |
| Michigan | 0.973 | 45 | 0.898 | 12 | Washington | 0.973 | 45 | 0.947 | 23 |
| Minnesota | 0.978 | 57 | 0.904 | 12 | West Virginia | 0.978 | 63 | 0.886 | 11 |
| Mississippi | 0.972 | 44 | 0.947 | 23 | Wisconsin | 0.977 | 55 | 0.900 | 12 |
| Missouri | 0.981 | 67 | 0.954 | 29 | Wyoming | 0.988 | 132 | 0.895 | 13 |

Table 5. Concordance Between State and National Business Cycles

| State | Concordance | Null expected concordance | State | Concordance | Null expected concordance |
|---------------|--------------------|----------------------------------|----------------|--------------------|----------------------------------|
| Alabama | 0.897 | 0.691 | Montana | 0.772 | 0.693 |
| Alaska | 0.217 | 0.284 | Nebraska | 0.801 | 0.631 |
| Arizona | 0.715 | 0.549 | Nevada | 0.918 | 0.698 |
| Arkansas | 0.861 | 0.681 | New Hampshire | 0.858 | 0.693 |
| California | 0.829 | 0.631 | New Jersey | 0.824 | 0.656 |
| Colorado | 0.762 | 0.631 | New Mexico | 0.719 | 0.554 |
| Connecticut | 0.826 | 0.641 | New York | 0.829 | 0.641 |
| Delaware | 0.669 | 0.531 | North Carolina | 0.911 | 0.688 |
| Florida | 0.879 | 0.698 | North Dakota | 0.790 | 0.721 |
| Georgia | 0.890 | 0.673 | Ohio | 0.909 | 0.688 |
| Hawaii | 0.555 | 0.511 | Oklahoma | 0.815 | 0.789 |
| Idaho | 0.840 | 0.691 | Oregon | 0.907 | 0.693 |
| Illinois | 0.858 | 0.651 | Pennsylvania | 0.907 | 0.683 |
| Indiana | 0.911 | 0.693 | Rhode Island | 0.847 | 0.648 |
| Iowa | 0.829 | 0.671 | South Carolina | 0.879 | 0.668 |
| Kansas | 0.929 | 0.786 | South Dakota | 0.801 | 0.658 |
| Kentucky | 0.911 | 0.733 | Tennessee | 0.886 | 0.666 |
| Louisiana | 0.741 | 0.718 | Texas | 0.820 | 0.738 |
| Maine | 0.662 | 0.509 | Utah | 0.762 | 0.623 |
| Maryland | 0.747 | 0.584 | Vermont | 0.868 | 0.661 |
| Massachusetts | 0.865 | 0.693 | Virginia | 0.871 | 0.663 |
| Michigan | 0.925 | 0.708 | Washington | 0.779 | 0.601 |
| Minnesota | 0.943 | 0.721 | West Virginia | 0.868 | 0.733 |
| Mississippi | 0.804 | 0.614 | Wisconsin | 0.932 | 0.713 |
| Missouri | 0.868 | 0.653 | Wyoming | 0.804 | 0.777 |

Figure 1. Monthly Recession Probabilities for Selected States, 1979.02 - 2002.06
(National NBER recessions indicated by shaded areas)

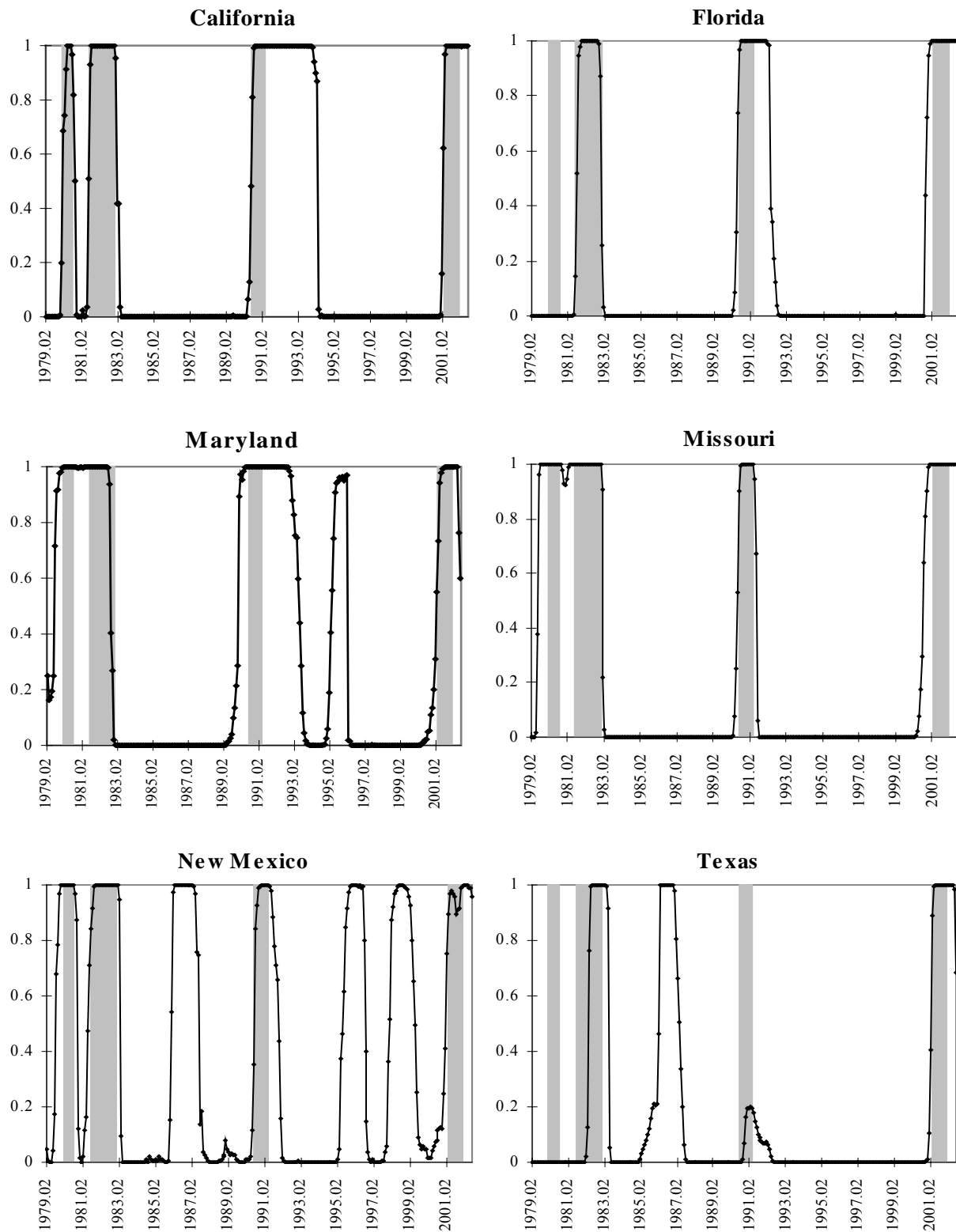


Figure 2. National Recessions 1980.I - 1980.III and 1981.III - 1982.IV

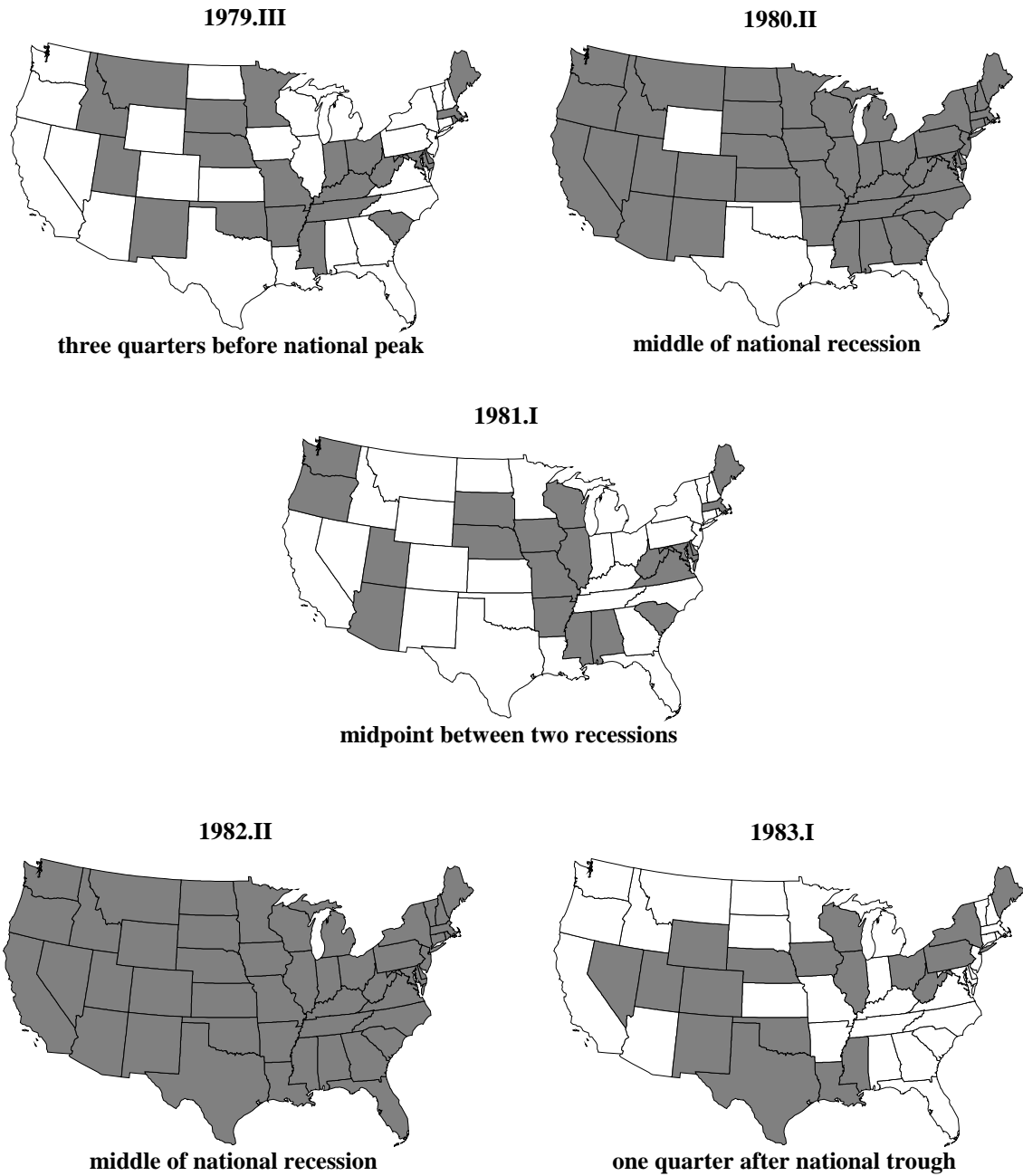


Figure 3. National Recession 1990.III - 1991.I

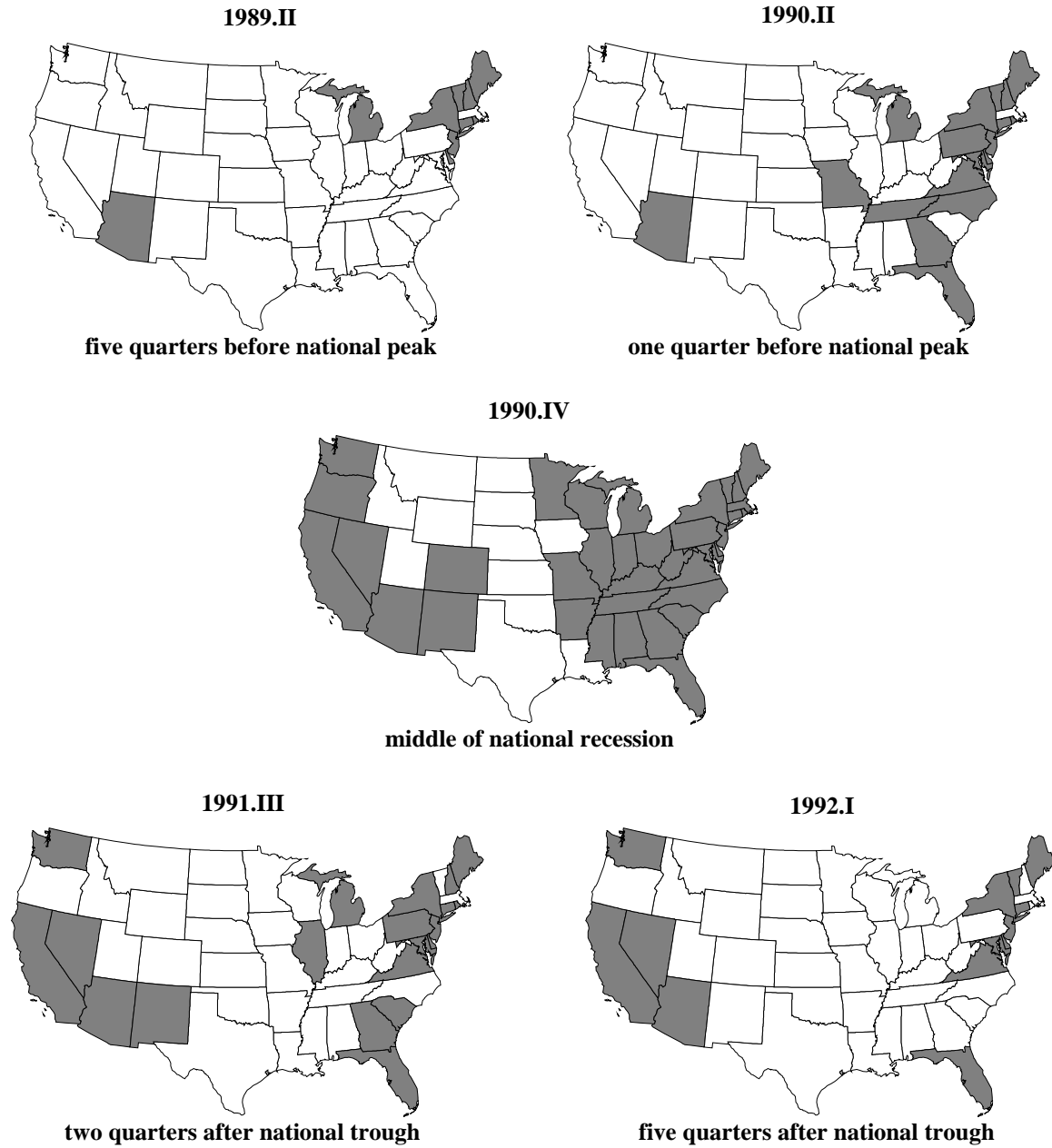


Figure 4. National Recession 2001.II - 2001.IV

